Docket No. DIET-003

APPLICATION

FOR UNITED STATES LETTERS PATENT

SPECIFICATION

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT I, **James P. Dietrich**, a citizen of the United States, have invented a new and useful conveyor belt scale system of which the following is a specification:

Conveyor Belt Scale System

CROSS REFERENCE TO RELATED APPLICATIONS

Not applicable to this application.

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH OR DEVELOPMENT

Not applicable to this application.

BACKGROUND OF THE INVENTION

Field of the Invention

The present invention relates generally to conveyor belt scales and more specifically it relates to a conveyor belt scale system for increasing the weight measurement accuracy of a conveyor belt scale.

Description of the Prior Art

Conveyor belts scales for measuring the amount of material transported upon a conveyor belt have been in use for years. A conventional conveyor belt scale is

positioned a finite distance along the conveyor belt after the location of depositing the material upon the conveyor belt. The conveyor belt scale must first be "zero calibrated" to determine the average weight of the belt. A control unit then subtracts the calculated average weight of the belt from the total weight read by the belt scale with a load to determine the approximate weight of the load. By simultaneously measuring the velocity of the conveyor belt, the total weight of material loaded and transported upon the conveyor belt may be approximately calculated.

The main problem with conventional conveyor belt scales is that they do not take into account that a conveyor belt typically has varying unloaded weights along the entire length. Conventional conveyor belt scales merely take into account the "average weight" of the belt when computing the weight of the loaded material.

Another problem with conventional conveyor belt scales is that they do not compensate for accumulated debris upon the conveyor belt during operation which over time increases the overall empty weight of the conveyor belt. Accumulated debris may include but is not limited to dirt, portions of the loaded material, moisture. Accumulated debris may also be in the "negative" wherein a portion of the conveyor belt has been accidentally removed thereby reducing the weight of the conveyor belt in that location. The solution for conventional conveyor belt scales is to terminate the loading of material upon the conveyor belt and "zero calibrate" the conveyor belt again. This must be performed repeatedly and is an inefficient usage of the conveyor belt.

~~While these devices may be suitable for the particular purpose to which they~~ address, they are not as suitable for increasing the weight measurement accuracy of a ~~conveyor belt scale. Conventional conveyor belt scales are not extremely accurate and~~ are prone to errors caused by location weight differences within the conveyor belt and accumulated debris.

In these respects, the conveyor belt scale system according to the present invention substantially departs from the conventional concepts and designs of the prior art, and in so doing provides an apparatus primarily developed for the purpose of increasing the weight measurement accuracy of a conveyor belt scale.

SUMMARY OF THE INVENTION

In view of the foregoing disadvantages inherent in the known types of conveyor belt scales now present in the prior art, the present invention provides a new conveyor belt scale system construction wherein the same can be utilized for increasing the weight measurement accuracy of a conveyor belt scale.

The general purpose of the present invention, which will be described subsequently in greater detail, is to provide a new conveyor belt scale system that has many of the advantages of the conveyor belt scales mentioned heretofore and many novel features that result in a new conveyor belt scale system which is not anticipated, rendered obvious, suggested, or even implied by any of the prior art conveyor belt scales, either alone or in any combination thereof.

To attain this, the present invention generally comprises a conveyor having a support frame and a belt, a first load cell positioned within the conveyor for measuring the belt after receiving a load of material (full weight), a second load cell positioned within the conveyor for measuring the belt prior to receiving a load of material (empty weight), a velocity sensor within the conveyor for measuring the velocity of the belt, and a control unit in communication with the sensors. The control unit measures the empty weight and the full weight of the belt upon a plurality of locations upon the belt. The control unit corresponds the empty weight with the full weight of each of the measured locations to calculate the material net weight.

There has thus been outlined, rather broadly, the more important features of the invention in order that the detailed description thereof may be better understood, and in order that the present contribution to the art may be better appreciated. There are additional features of the invention that will be described hereinafter and that will form

the subject matter of the claims appended hereto.

In this respect, before explaining at least one embodiment of the invention in detail, it is to be understood that the invention is not limited in its application to the details of construction and to the arrangements of the components set forth in the following description or illustrated in the drawings. The invention is capable of other embodiments and of being practiced and carried out in various ways. Also, it is to be understood that the phraseology and terminology employed herein are for the purpose of the description and should not be regarded as limiting.

A primary object of the present invention is to provide a conveyor belt scale system that will overcome the shortcomings of the prior art devices.

A second object is to provide a conveyor belt scale system for increasing the weight measurement accuracy of a conveyor belt scale.

Another object is to provide a conveyor belt scale system that constantly calculates the empty weight of specific locations of a conveyor belt during operation of the belt.

An additional object is to provide a conveyor belt scale system that does not require repeated stoppage of the conveyor belt.

A further object is to provide a conveyor belt scale system that can be utilized upon various types of conveyor belts and retrofitted easily to existing conveyor belt scale systems.

Another object is to provide a conveyor belt scale system that is capable of compensating for dynamic changes in the empty weight of a conveyor belt while the belt is in a continuous loaded state.

Other objects and advantages of the present invention will become obvious to the reader and it is intended that these objects and advantages are within the scope of the present invention.

To the accomplishment of the above and related objects, this invention may be embodied in the form illustrated in the accompanying drawings, attention being called to the fact, however, that the drawings are illustrative only, and that changes may be made in the specific construction illustrated and described within the scope of the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

Various other objects, features and attendant advantages of the present invention will become fully appreciated as the same becomes better understood when considered in conjunction with the accompanying drawings, in which like reference characters designate the same or similar parts throughout the several views, and wherein:

FIG. 1 is a side view of the present invention.

FIG. 2 is a block diagram of the present invention.

FIG. 3 is an upper perspective view of the present invention.

FIG. 4 is a cross sectional view taken along line 4-4 of Figure 3.

FIG. 5 is a magnified side view of the present invention with a load positioned upon the conveyor belt.

FIG. 6 is a magnified upper perspective view of the second load cell supporting the lower roller.

FIG. 7 is a side view of an alternative embodiment wherein the second load cell is positioned within the upper portion of the belt prior to entry of the material.

FIG. 8 is a chart providing an example of the data and calculations received and performed by the control unit.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Turning now descriptively to the drawings, in which similar reference characters denote similar elements throughout the several views, FIGS. 1 through 8 illustrate a conveyor belt scale system **10**, which comprises a conveyor having a support frame **21** and a belt **20**, a first load cell **40** positioned within the conveyor for measuring the belt **20** after receiving a load of material **12** (full weight), a second load cell **50** positioned within the conveyor for measuring the belt **20** prior to receiving a load of material **12** (empty weight), a velocity sensor **60** within the conveyor for measuring the velocity of the belt **20**, and a control unit **42** in communication with the sensors. The control unit **42** measures the empty weight and the full weight of the belt **20** upon a plurality of locations upon the belt **20**. The control unit **42** corresponds the empty weight with the full weight of each of the measured locations to calculate the material **12** net weight.

As shown in Figures 3, 5 and 7 of the drawings, the conveyor is comprised of an elongate support frame **21** with an endless belt **20** rotatably positioned upon the support frame **21** in a longitudinal manner. A first end roller **28** and a second end roller **29** rotatably attached to the support frame **21** allow the belt **20** to rotatably travel continuously upon the conveyor. A conventional drive motor is connected to at least one of the rollers for driving the endless belt **20** as is well established in the art.

A plurality of rollers **82, 84** are rotatably positioned within the support frame **21** for supporting the upper portion **22** of the belt **20** as shown in Figures 3 and 4 of the drawings. The plurality of rollers **82, 84** may have various structures such as flat, U-shape, V-shaped and the like. Figures 3 and 4 illustrate the usage of a pair of side rollers **82** and a middle roller **84** rotatably attached to a cross member **80** and support structure extending from the cross member **80**. It can be appreciated that the upper

roller structure for the conveyor may be comprised of various other roller structures not illustrated within the figures. As further shown in Figures 3, 4, 5 and 7 of the drawings, a plurality of lower rollers **26** are rotatably attached to the support frame **21** for supporting the lower portion **23** of the endless belt **20** during the non-load phase. The exemplary conveyor may have various other structures other than that illustrated within the figures as can be appreciated.

As further shown in Figures 3, 5 and 7 of the drawings, the belt **20** has an upper portion **22** (load side) and a lower portion **23** (non-load side). The endless belt **20** may have a flat shape, curved shape or other shape commonly utilized within conventional conveyors for transporting material **12** and items. The endless belt **20** may include various additional structures commonly utilized with endless belts. The endless belt **20** may also be comprised of various types of flexible materials that are well known in the conveyor industry.

As shown in Figure 1 of the drawings, a first load cell **40** is positioned to measure the weight of the upper portion **22** of the endless belt **20** transporting the material **12**. The first load cell **40** may be positioned at various locations along the upper portion **22** of the endless track after the location of the material dispenser **30**. The first load cell **40** measures the combined weight of a position upon the endless belt **20** and the material **12** being transported. The first load cell **40** may be attached as a pivoted or full floating suspension system.

Figure 3 illustrates the usage of a first member **70** and a second member **76** attached about the support frame **21** traverse to the endless belt **20**. A pair of support members **72** are pivotally attached to the first member **70** as best shown in Figure 3 of the drawings. The support members **72** pivotally extend from the first member **70** and are connected to a lower member **74** positioned directly below the second member **76** as shown in Figure 4 of the drawings. The lower member **74** is attached to the lower

surface of the second member **76** by the first load cell **40** as shown in Figure 4 of the drawings. A cross member **80** supporting a pair of side rollers **82** and a middle roller **84** is attached to the support members **72** near the second member **76** as shown in Figure 3 of the drawings. A pair of cutouts **25** within the side members of the support frame **21** allow the cross member **80** attached to the support members **72** to freely move upwardly and downwardly based upon the weight of the belt **20** and material **12**. The first load cell **40** calculates the downward force applied to the support members **72** to calculate the gross weight of a position upon the endless belt **20** containing the material **12** (gross full weight). The first load cell **40** is preferably comprised of a tension load cell structure, but may be comprised of a compression load cell structure by repositioning the first load cell **40** with respect to the lower member **74** so that the first load cell **40** is positioned non-movably with respect to the support frame **21** such as by a brace member or the like.

As further shown in Figure 1 of the drawings, a second load cell **50** is positioned to measure the weight of the lower portion **23** of the endless belt **20**. The second load cell **50** may be positioned at various locations along the lower portion **23** of the endless track after the material **12** has been removed from the upper portion **22** of the belt **20**. The second load cell **50** measures the "empty" weight of a position upon the endless belt **20** (gross empty weight). The second load cell **50** may be comprised of a tension or compression load cell structure.

As shown in Figures 3 and 4 of the drawings, a pair of second load cells **50** are preferably attached to and supporting one or more of the lower rollers **26** by a pair of brackets **52**. As shown in Figure 6 of the drawings, the upper load cell is attached to the side of the support frame **21** is the bracket is applying a compression force upon the second load cell **50**. It can be appreciated that the second load cell **50** may be comprised of a tension load cell design by reconfiguring the position of the bracket and the second load cell **50**.

Figure 7 illustrates an alternative embodiment of the present invention wherein the second load cell **50** is positioned with respect to the upper portion **22** of the endless belt **20** prior to entry of the material **12** to measure the empty weight of the belt **20**. Similar to the first load cell **40** structure, Figure 7 illustrates the usage of a first member **70** and a second member **76** attached about the support frame **21** traverse to the endless belt **20**. A pair of support members **72** are pivotally attached to the first member **70** similar to that shown in Figure 3 of the drawings. The support members **72** pivotally extend from the first member **70** and are connected to a lower member **74** positioned directly below the second member **76** similar to that shown in Figure 4 of the drawings. The lower member **74** is attached to the lower surface of the second member **76** by the first load cell **40**. A cross member **80** supporting a pair of side rollers **82** and a middle roller **84** is attached to the support members **72** near the second member **76** similar to that shown in Figure 3 of the drawings. A pair of cutouts **25** within the side members of the support frame **21** allow the cross member **80** attached to the support members **72** to freely move upwardly and downwardly based upon the weight of the belt **20** and material **12** as shown in Figure 7. The second load cell **50** calculates the downward force applied to the support members **72** to calculate the gross weight of a position upon the endless belt **20** (gross empty weight). The second load cell **50** is preferably comprised of a tension load cell structure, but may be comprised of a compression load cell structure by repositioning the second load cell **50** with respect to the lower member **74** so that the second load cell **50** is positioned non-movably with respect to the support frame **21** such as by a brace member or the like. The advantage of the alternative embodiment is that the measurement of the gross empty weight occurs closer to the measurement of the gross full weight thereby reducing the likelihood of changes in the gross empty weight prior to measuring the gross full weight.

As shown in Figure 1 of the drawings, a velocity sensor **60** is connected to the first end roller **28**. The velocity sensor **60** measures the rotational velocity of the first end roller **28** and by using the known diameter of the first end roller **28** the control unit **42** is able to calculate the longitudinal velocity of the belt **20**. It can be appreciated that various other known sensors may be utilized to measure and calculate the velocity of the endless belt **20**.

As shown in Figure 2 of the drawings, the control unit **42** is in communication with the velocity sensor **60**, the first load cell **40** and the second load cell **50**. The sensors **40**, **50** and **60** may be in communication with the control unit **42** via various communication means such as wireless, electrical wire and the like. The control unit **42** is capable of performing taring calculations and the like utilizing a computer or similar electronic design which are well-known in the art. The control unit **42** is able to monitor specific locations upon the endless belt **20** by using the data received from the velocity sensor **60** thereby eliminating the need for a "marker" upon the endless belt **20**. The control unit **42** first receives a measurement of the gross empty weight upon a position P1 from the second load cell **50**. By using the velocity data from the velocity sensor **60** along with know distance parameters, the control unit **42** is able to calculate when position P1 is directly above the supporting rollers **82, 84** that are applying a downward force upon the first load cell **40**. The control unit **42** then receives a measurement of the gross full weight of position P1 from the first load cell **40**. The control unit **42** is able to subtract the gross empty weight from the gross full weight of position P1 to calculate the net weight of the material **12** being loaded and transported upon the upper portion **22** of the belt **20** as shown in the example of Figure 8. It can be appreciated that a plurality of positions (P1, P2, P3, P4, P4 . . . Pn) are measured by the control unit **42** along the endless belt **20**. This process continues during the entire operation of the conveyor until the conveyor is terminated. The control unit **42** can increase the accuracy of the net weight measurement by increasing the total number of positions measured along the length of the endless belt **20**. As is

well known in the art, the calculated net weight of the material **12** is utilized in conjunction with the measured velocity of the endless belt **20** to calculate the total material **12** loaded and transported upon the endless belt **20** over a period of time which may be shown upon the display **44** or other device.

As to a further discussion of the manner of usage and operation of the present invention, the same should be apparent from the above description. Accordingly, no further discussion relating to the manner of usage and operation will be provided.

With respect to the above description then, it is to be realized that the optimum dimensional relationships for the parts of the invention, to include variations in size, materials, shape, form, function and manner of operation, assembly and use, are deemed to be within the expertise of those skilled in the art, and all equivalent structural variations and relationships to those illustrated in the drawings and described in the specification are intended to be encompassed by the present invention.

Therefore, the foregoing is considered as illustrative only of the principles of the invention. Further, since numerous modifications and changes will readily occur to those skilled in the art, it is not desired to limit the invention to the exact construction and operation shown and described, and accordingly, all suitable modifications and equivalents may be resorted to, falling within the scope of the invention.